Vol. VIII No. 1 March 1956

R

DIRECTORATE OF PLANT PROTECTION, QUARANTINE AND STORAGE
MINISTRY OF FOOD AND AGRICULTURE, GOVERNMENT OF INDIA

PLANT PROTECTION BULLETIN

SCIENCE IN PRACTICE

सत्यमेव जयते

Issued by the
PLANT PROTECTION ADVISER TO THE GOVERNMENT OF INDIA,
NEW DELHI.

[1959] (see last page)

DPP. 2. VIII 1
500

Published Quarterly

		Inland	Foreign
SUBSCRIPTION RATES	Single Copy	Re. 0.75 nP.	1*sh.*
	Annual	Rs. 3.00	5*sh.*

Available from:

THE MANAGER OF PUBLICATIONS, CIVIL LINES, DELHI—8.

Vol. VIII No. 1 March 1956

DIRECTORATE OF PLANT PROTECTION, QUARANTINE AND STORAGE
MINISTRY OF FOOD AND AGRICULTURE, GOVERNMENT OF INDIA

PLANT PROTECTION BULLETIN

SCIENCE IN PRACTICE

Issued by the
PLANT PROTECTION ADVISER TO THE GOVERNMENT OF INDIA,
NEW DELHI.

NOTE

This Bulletin is intended to disseminate information about plant protection measures and campaigns adopted or conducted in different parts of India as well as about the advances made in the field of plant protection in other parts of the world, to the extent possible. It is also intended to give information about the latest developments in the production of pesticides, plant protection equipment and techniques of pest and plant disease control. Elaborate scientific papers on Entomology or Plant Pathology or on the chemistry of pesticides would normally not be in place in this Bulletin but short notes dealing with the behaviour or distribution of pests and plant diseases and brief reports on their epidemiology, control, etc., would be welcome. Plant protection has now become such a specialised science and yet is so diversified and consequential in its character and application that it is difficult to define the scope of the subject with any great precision. The general rule to be observed is that any information which can be useful in preventing or controlling damage to crops, fruit trees, plantations and stored agricultural commodities, caused by pests and diseases, should be a fit subject for publication in this Bulletin.

Manuscripts submitted for publication in the Plant Protection Bulletin must be typed in double spacing on one side of the paper only, leaving ample margin on the left, at the bottom and on the top of the page. Photographs or drawings must be accompanied by a clearly typed legend for being reproduced under them. In addition, they should bear, on the reverse, in clear handwriting in pencil, the name or names of the author or authors and the article which they illustrate. Local names of insects, diseases, weeds, crops and plants, if used, must be commenced with a small, not capital, letter and underlined and must invariably be followed by their scientific or well known English names. Localities or place names should be clearly indicated by reference to well known districts or States or both.

While this Directorate will take every care to include only such material in the Bulletin as may be considered reasonably correct and useful, it can accept no responsibility for every statement made and every opinion expressed. Due to various unavoidable reasons, the appearance of this Bulletin has been far behind the scheduled time. While this is greatly regretted, every effort would be made to avoid delays in future. Those who may read this Bulletin are invited to offer criticisms and suggestions for its improvement.

K. B. LAL
PLANT PROTECTION ADVISER TO THE
GOVERNMENT OF INDIA

New Delhi

FUMIGATION OF IMPORTED AMERICAN AND WEST INDIES COTTON AT BOMBAY

BY

V. K. SUBRAMANYAM,

Plant Quarantine Entomologist,

Plant Quarantine and Fumigation Station, Bombay.

According to the Destructive Insects and Pests Act (1914) of India, all American cotton, imported into this country, is required to be fumigated with Hydrocyanic acid gas or with any other suitable fumigant. This is a precaution taken against the possible entry of the Mexican boll weevil, (*Anthonomus grandis* Boh.), into this country. Prior to the First World War, India imported on an average 25,000 bales of American cotton per annum. As the imports showed a tendency to increase, the question arose as to whether the Mexican boll weevil, which caused enormous damage to cotton in the U.S.A., might not find its way into this country and imperil our cotton industry. This aspect was thoroughly investigated and it was concluded that such a danger did exist; furthermore, an evaluation of the known facts of the life-history of the insect and the climatic conditions existing in our cotton growing belt led to the belief that once the pest was introduced, it could establish itself and spread far and wide. The Indian Central Cotton Committee, therefore, carried out experiments on the fumigation of cotton and proposed to the Government of India that all American cotton should be fumigated at the port of arrival. The Government of India issued a notification in 1925 under the Destructive Insects and Pests Act of 1914, whereby fumigation of American cotton became mandatory and the Indian Central Cotton Committee formulated what was known as the fumigation of American Cotton Scheme and commenced the fumigation of American cotton in December 1925. In January, 1953, the Directorate of Plant Protection, Quarantine & Storage, took over this work from the Indian Central Cotton Committee.

On an average, about 1 lakh bales of American cotton are imported every year through the port of Bombay, though, during some years in the past, the imports have gone beyond 2 lakhs. These imports are not equally distributed during the 12 months of the year and the bulk of the imports arrive during November to March. Very often single shipments carrying about 15 to 20 thousand bales may arrive at short intervals, during the peak periods of import. Considering that each barge, employed for fumigation, has to be turned round for fresh loading every third day or so and that the fumigation capacity is limited to about 1,000 bales at any time, several operations have to be carried out with the greatest speed to avoid accumulation. The magnitude of the work can be judged from the fact that during each day, cotton bales occupying 34,500 cu. ft. in volume, have to be fumigated.

American cotton bales (which are about 5' X 2½' X 2' in size) arriving by steamers, are unloaded into steel barges, which are towed alongside the ship for this purpose. The cotton bales are stacked within the barge holds in such a manner that some space is provided between the bales to facilitate circulation of air. This is done by employing wooden battens between the layers of bales. Each medium sized barge holds about 250 bales. These steel barges serve as floating fumigation chambers.

After the holds are full, the barges are towed back to the fumigation wharf and after they are moored, further preparations for the fumigation of the bales are put under way. To begin with, a branching system of flexible pipes, known as "gas trunk pipes", are laid out in the hold (Plate I, Fig. 2) of the barge. This system of pipes is a device to facilitate circulation of the gas to all corners of the hold and has a main trunk of a flexible pipe of about 6 in. diameter. The terminal outlets of the branches are about 3 in. in diameter. The hold is next covered with a gas-proof cover. The borders are reinforced with thick rubber tape. Two holes with sleeves are provided at one end. The main end of the gas trunk pipe, already referred to, is now drawn out through one of the holes in the cover and the sleeve is wrapped round it securely. The borders of the cover are now drawn over the hatches and battened with wooden wedges (Plate I, Fig. 1). The rubber tape provided on the borders of the cover, serves to provide a leak-proof joint all round. The hold containing the bales of cotton is now ready for fumigation.

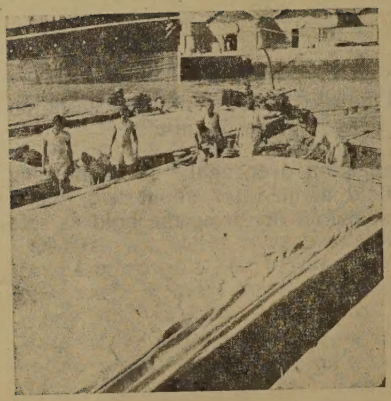
The fumigation is carried out by employing a fumigating machine, known as the Liston Fumigator, which was developed by Lt. Col. Glen Liston, I.M.S., for the fumigation of shipholds in India, and is specially suitable for this purpose. This machine is in principle similar to the one employed in the U.S.A. for fumigation of freight cars. The Liston Fumigator (Plate I, Figs. 3/4) consists of a rectangular Box (A). The lid (B) is mounted on coasters and fixed to the box by means of flanges, so that it can be removed completely. On one side of this lid, there is a small petrol engine (C), which drives an enclosed blower fan (D). The engine is capable of driving the fan at about 3,600 RPM and can deliver 1,200 cu. ft. of air per minute. The intake of this blower fan is connected by means of a flexible pipe (E) to the interior of the hold, through one of the two holes in the hatch cover. The outlet of the fan is connected to the interior of the box, through the connection (F). An outlet is provided to the box (F) and this is connected to the main trunk of the branching system of pipes, which was drawn out through the other hole in the hatch cover and secured to the sleeve while covering the hatch. The joints of the box, pipes, etc., are caulked to prevent leakage. When the blower works, air is drawn from the hold through the pipe (E) and forced back through the pipe (F_1) and its branches. A thorough circulation is, therefore, effected.

On the other side of the machine a rack is provided, on which two Winchester bottles (H) from which the bottoms have been removed, are held upside down. They are provided with delivery tubes and pinch cocks. The delivery tubes (J & K) pass through the lid and overlie a slopping trough, which is situated within the chamber. The two bottles are filled with Sulphuric acid and Sodium cyanide solutions respectively, and when these are allowed to pass through the delivery tubes, they come in contact with each other in the trough within the chamber and immediately generate Hydrocyanic acid gas. The gas so generated is circulated to all parts of the hold by the blower, which is kept working.

For the effective fumigation of American cotton, a concentration of 5,000 parts of the gas per million parts of air for 4 hours' duration or a concentration of 1,500 parts of the gas per million parts of air for 20 hours' duration, is required to be maintained. The concentration of the gas within the hold, which is estimated by aspirating a known volume of the air from within it through Sodium hydroxide solution and then titrating the absorbed HCN against Silver nitrate of known normality, is determined

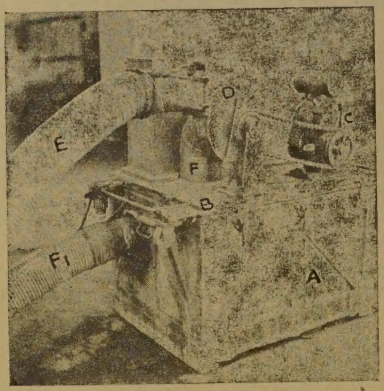
at intervals of 2-3 hours for the first 8 hours. In case the concentration falls below the required level, a booster dose is given to raise it.

The cotton bales are kept under fumigation over-night. Next morning the barge covers are opened and the hold aerated for about two hours, and tests carried out for any residual gas, before declaring the hold as safe for unloading.

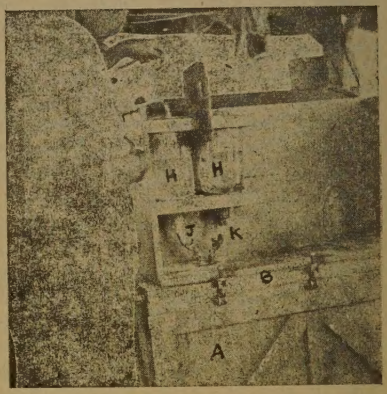


1

2



3



4

PLATE I

Fig. 1. Covering and fixing fumigation cover
Fig. 2. Laying gas trunk pipes in the hold
Fig. 3. Liston machine showing engine and blower
Fig. 4. Liston machine showing containers for chemicals

A CAMPAIGN AGAINST SAN JOSE SCALE IN HIMACHAL PRADESH

BY

L. N. NIGAM AND M. V. VENKATESH,
Directorate of Plant Protection, Quarantine and Storage, New Delhi.

Introduction

Himachal Pradesh is one of the most important apple growing areas in the Siwalik hills of the Lower Himalayan range, the total area under cultivation being estimated at 730 acres in 1954. Of late, considerable expansion of apple cultivation has taken place. It is also cultivated in the hilly regions of the neighbouring States of Jammu and Kashmir, Punjab and Uttar Pradesh.

The apple industry of Himachal Pradesh suffers an appreciable loss due to the damage caused to the fruits and other parts of the plant by San Jose scale, wooly aphis, stem borer (*Zeuzera* sp.) and root borer (*Dorysthenes* sp.). Of these, San Jose scale is the most destructive.

The optimum conditions for the multiplication of the pest obtain within a range of elevation varying from 5,000 ft. to 6,000 ft. The incidence of the pest was higher in orchards located at lower altitudes, *e.g.*, Sutla (5,700 ft.) Kiari (5,500 ft.) and Kotkhai (5,200 ft.). The incidence seemed to decrease as the elevation increased. At an altitude of 7,800 ft. (Thanedar) the incidence was very low. In Roga orchards, the plants at a higher altitude showed a lower incidence as compared to the plants growing in the lower valley portion of the same orchards.

In 1954, a large-scale campaign against San Jose scale was organised by the Department of Agriculture, Himachal Pradesh, in collaboration with the Directorate of Plant Protection, Quarantine and Storage. Supplies of insecticides, *viz.*, Diesel oil and Potash Fish oil soap were arranged by the Directorate of Plant Protection, Quarantine and Storage. The total area of about 730 acres was divided into three centres *viz.*, (1) Kotgarh, (2) Kotkhai and (3) Mashobra. The Kotgarh centre, comprising about 450 acres, was divided into Thanedar, Kotgarh and Bhuti sub-centres. The Kotkhai centre, comprising about 200 acres, was divided into Kotkhai and Kiari sub-centres. The Mashobra centre located in the vicinity of Simla covered an area of about 80 acres. In all, about 2,100 gallons of Diesel oil and 6,230 lbs. of Potash Fish oil soap were utilised.

The work was first started in Thanedar sub-centre. A schedule of work was drawn up and the orchardists were informed of the programme of work in their respective areas in advance.

Method of work

(*a*) *Preparation of stock solution of Diesel oil emulsions*—

The emulsion was prepared according to the following formula :—

Light Diesel oil	.. ..	5.0 seers
Potash Fish oil soap	.. ..	1.5 seers
Water	.. ..	14.0 seers

Water was heated in a drum to which soap was added and the solution was allowed to boil for 2-3 minutes. The fire was then reduced and Diesel oil was gradually added, the mixture being continuously stirred with a wooden rod to emulsify the oil. The mixture was allowed to cool for some time and then vigorously churned by pumping it with a sprayer 3-4 times till a homogeneous emulsion was obtained.

The stock solution was prepared fresh every day as far as possible. It contained 24.4% oil and was diluted with seven parts of water to give a spray solution with about 3.48% oil content. For trees with low insect infestation, the stock solution was diluted up to 8 times to contain about 2.7% oil.

(*b*) *Technique of spraying.*—Thorough spraying was done so as to drench every part of the tree, as the scales, which are not touched by the solution, multiply after spraying and nullify the efforts.

(*c*) *Record of observations.*—Observations on the quantity of the spray materials used, number of trees sprayed, time taken and labour involved etc., were recorded on a prescribed proforma.

Cost of operations

The cost of spraying varied with the number of trees covered per day with a machine. On an average, 150 to 200 big trees could be sprayed per working day of 6-7 hours with the "P.M.S. quick lift type" power sprayer and 75—100 trees with the John Bean spartan power sprayer. Where the trees were small, a larger number of them were sprayed. The water supply was on contract basis at the rate of two annas per tin of 4 gallons. The cost of spraying worked out to five annas and ten pies per tree of average size. In the case of younger trees, below ten years of age, the spray material needed was much less and the cost went down to two and a half annas per tree. A record of the expenditure incurred in an orchard, where 850 average sized trees were sprayed, is given below :—

1.	Diesel oil	50 gallons	Rs. 81—4—0
2.	Soap	126 lbs.	Rs. 86–10—0
3.	Water	1470 gallons	Rs. 45–15—0
4.	Petrol	3·5 gallons	Rs. 10—1—0
5.	Fire wood	6 maunds	Rs. 3—0—0
6.	Labour	48 men	Rs. 81—0—0
		Total	Rs. 307–14—0
		No. of trees sprayed	850
		Average cost per tree	Rs. 0—5–10

From the above, it will be observed that the cost of the insecticide alone (including water and firewood) was about four annas and two pies only and that of labour and petrol (for power sprayer) was one anna and six pies and two pies per tree, respectively.

Observations and results

Observations on the population of the living and dead scales were made on a number of trees before and after spraying. Three observations on the mortality of the scales were made 7, 14 and 40 days after spraying, on the sprayed and check plants. The intensity of the pest was also studied in the following spring, when the pest revived its activity. The results (as given below) indicated that the normal mortality in the unsprayed plants varied

from 42.8 to 57.1% in the various observations, while in the treated plants it varied from 71.1 to 94.3%. The maximum mortality of 94.3% was obtained about two weeks after spraying.

Morality percentage of the pest

	Before Spraying	7 days after Spraying	14 days after Spraying	40 days after Spraying	4 1/2 months after Spraying
Sprayed	47·9	71·1	94·3	71·1	88·6
Unsprayed (check) ..	42·8	54·2	—	51·4	57·1

The campaign was fairly successful in arresting the activity of the pest. In all 72,900 apple trees were sprayed over an area of about 739 acres. The orchardists evinced a keen interest and co-operated whole-heartedly in the campaign.

Acknowledgement

The campaign was conducted at the instance of Dr. Pushkar Nath, Director of Agriculture, Himachal Pradesh. We are thankful to him for his keen interest in the campaign and for the facilities provided for it.

PRELIMINARY TRIALS OF SOME ANTI-LOCUST INSECTICIDES

BY

D. R. BHATIA, M.Sc. (HONS.), F.E.S.I., S. K. SUR, M.Sc.,
AND D. S. GUPTA, B.Sc. (HONS.), AGRIC.
Directorate of Plant Protection, Quarantine and Storage,
Locust Sub-Station, Jodhpur.

Introduction

In India till 1948, mostly mechanical methods were employed for the control of the desert locust (*Schistocerca gregaria* Forsk.), though baiting with sodium fluosilicate as poison and wheat bran as carrier was also done to some extent. Benzene hexachloride (BHC) dust was used for the first time in 1949 when a locust plague (1949) commenced.

Since 1951, aldrin has also been used in anti-locust campaigns. Pruthi, Bhatia and Mathur (1952), and Pruthi and Bhatia (1954) studied the use of aldrin as an anti-locust insecticide. The present authors made some preliminary observations on the comparative toxicity of some of the new insecticides and their findings are briefly given in this article.

Material and method

The following insecticides were tried :—

1. *Benzene hexachloride dust* (received from Imperial Chemical Industries Ltd., (India). The technical BHC contains about 13% of gamma isomer. It was received as 50% dust and formulated to different strengths by adding talc.
2. *Lindane emulsion* (received from U.S.A. under the Technical Co-operation Assistance programme). Lindane contains at least 99% of the gamma isomer of benzene hexachloride. It was received as 20% emulsion concentrate and diluted to the desired strength by adding water.
3. *Acrodel* (received from Imperial Chemical Industries Ltd., India). Acrodel is a concentrated liquid formulation of the gamma isomer of benzene hexachloride (gamma BHC), suitable for dilution with kerosene, paraffin, or diesel oil. The sample received for trial contained 12% gamma BHC and was diluted to the desired strength by adding kerosene oil.
4. *Intox* '8' *dust* (a Sandoz product received from M/s. Atlas Fertilizers Ltd., Calcutta). Intox '8' is a mixture of 2% Chlordane and 3% BHC. It was received as 5% and 10% dusts and the required strengths were obtained by adding talc.
5. *Heptachlor dust and emulsion* (received from U.S.A. under T.C.A.). It was received as 25% dust and 20% emulsion concentrate. The stocks were diluted by adding talc to the dust or water to the emulsion, as the case may be.
6. *Aldrin dust* (received from John Powell & Co., New York U.S.A.). It was received as 20% dust and diluted by adding talc.

The field trials were carried out against hoppers and adults of the desert locust at Lathi (27° 02' N 71°30' E), Osian (26 42' N 72 54' E) and Didwana 27 24' N 74 30' E) in Jodhpur division. Free hopper bands were treated with various insecticides and kept for observations in tin sheet enclosures (about 45 sq. ft.). In the case of adults the insecticides were applied after enclosing 25 pink adults in smilar tin sheet enclosures covered over by wire gauze. The results are based on the average of two observations.

Observations

Observations on the comparative toxicity of various insecticides are summarised below :—

Dusts

Strength used (%)	Dose per acre (in lbs.)	Hopper stage/Colour of adults	Results
BENZENE HEXACHLORIDE			
1·25	14·8	I	80% killed and 20% knocked down within 4 hours.
2·5	18·0	III	100% killed within 20 hours.
5·0	19·0	III	50% killed and 50% knocked down within 2 hours.
5·0	19·5	V	40% killed within 4 hours. 100% killed within 23 hours.
7·0	16·3	V	35% killed and 65% knocked down within 4 hours.
10·0	16·3	V	80% killed within 1 hour. 100% killed within 5 hours.
5·0	16·3	Pink adults	20% killed and 30% knocked down within 46 hours.
7·0	15·2	,,	50% killed and 35% knocked down within 46 hours.
10·0	17·4	,,	100% killed within 28 hours.
HEPTACHLOR			
2·5	19·6	III	100% killed within 26 hours.
5·0	10·6	III	No marked changes up to 17 hours.
5·0	26·0	III	100% killed within 8 hours.
5·0	21·5	V	20% killed and 35% knocked down within 4 hours.
7·0	18·0	V	100% killed within 22 hours.
10·0	19·5	V	20% killed and 80% knocked down within 2 hours.
5·0	15·2	Pink adults	Practically no effect observed upto 46 hours.
7·0	13·0	,,	10% killed and 20% knocked down within 46 hours.
10·0	16·3	,,	35% killed and 55% knocked down within 28 hours. 60% killed and 40% knocked down within 46 hours.
INTOX '8'			
1·25	15·8	I	60% knocked down within 23 hours.
2·5	14·4	I	100% killed within 21 hours.
2·5	18·3	III	70% killed within 27 hours.
5·0	11·2	III	Practically no effect observed upto 17 hours.
5·0	25·3	III	60% killed within 7 hours.
5·0	14·8	V	25% killed within 30 hours
10·0	13·3	V	60% killed and the rest knocked down with in 32 hours. First sign of death observed after 6 hours.
ALDRIN			
1·0	20·5	I	100% killed within 3 hours.
1·0	24·7	III	100% killed within 8 hours.
1·0	18·5	V	No marked effect observed up22 to hours.

Sprays

Concentration (%)	Dose per acre (gls.).	Hopper stage/ Colour of adults.	Results.
LINDANE EMULSION			
0·05	12·0	I	100% knocked down within 1 hour.
0·05	13·8	III	100% killed within 20 hours.
0·1	11·3	III	100% killed within 8 hours.
0·2	12·6	III	100% killed within 4 hours.
0·1	7·3	V	100% killed within 26 hours.
0·2	10·3	V	70% killed and 30% knocked down within 4 hours.
0·3	5·8	V	50% knocked down within 1 hour. 100% killed within 24 hours.
0·1	7·4	Pink adults.	90% killed and 10% knocked down within 46 hours.
0·2	15·4	„	80% killed and 20% knocked down within 5 hours.
0·3	5·8	„	90% killed and 10% knocked down within 46 hours.
HEPTACHLOR EMULSION			
0·05	14·0	I	100% killed within 16 hours.
0·05	12·6	III	20% killed within 28 hours.
0·1	12·6	III	80% killed within 7 hours.
0·2	11·0	III	100% killed within 6 hours.
0·1	7·1	V	88% killed within 48 hours.
0·2	11·4	V	100% killed within 27 hours.
0·3	6·3	V	90% killed and 10% knocked down within 46 hours
0·1	7·1	Pink adults	75% killed within 46 hours.
0·2	14·8	„	100% killed within 28 hours.
0·3	6·3	„	52% killed within 28 hours. 90% killed within 48 hours.
ACRODEL			
3/4 pint to a gallon of kerosene oil	2·6	V	100% killed within 1 hour.
1/4 „	1·9	V	100% killed within 6 hours.
1/8 „	2·2	V	100% killed within 9 hours.

Conclusions

From the above data the following conclusions may tentatively be drawn :—

(*a*) BHC dust is more effective on hoppers and pink adults than Heptachlor or Intox '8' dust of the same strength. Heptachlor dust is better than Intox '8' dust.

(*b*) Lindane 0.05% emulsion was effective against I to III stage hoppers though the kill was rather slow in the case of III stages. In the case of V stage hoppers and pink adults 0.2% solution gave quick results whereas 0.1%, though effective, was slow in action.

(*c*) Lindane emulsion was more effective against hoppers or pink adults than Heptachlor emulsion of the same strength.

(*d*) Acrodel was very effective against V stage hoppers; the strength of 3/4 pint to a gallon of kerosene oil gave 100% kill in one

hour when applied at the rate of 2.6 gallons per acre. The strength of 1/8 pint to a gallon also gave 100% kill within 9 hours.

References

PRUTHI, H. S. BHATIA, D. R., AND MATHUR, *C. B.*, 1952, *Indian J. Ent.*, 14 (3) : 273-296.

PRUTHI, H. S., AND BHATIA, D. R., 1954, *Indian J. Ent.*, 16 (3) : 261-270.

CONTROL OF THE *CHOLAM* EARHEAD BUG WITH BHC IN COIMBATORE

BY

K. R. NAGARAJAN, B.Sc. (AG.),
Crop and Plant Protection Officer (Entomology), Coimbatore,
and
J. J. D. EDWARDS, B.Sc. (AG.),
Plant Protection Assistant (Entomology), Coimbatore.

Cholam (*Andropogon sorghum*) is an important millet of Coimbatore and is raised both under irrigated and unirrigated conditions. It is damaged by a number of pests, the most important being the earhead bug, *Calocoris angustatus* Leth. It is distributed almost throughout the Madras State, occurring in varying degrees of severity in different years. It was first recorded from South Arcot district in 1891. It has established itself well in and around Coimbatore and is noticed almost every year on the *chitrai cholam,* which is an irrigated crop occupying about 15,300 acres.

Stray adults appear when the crop is in the flowering stage but multiply very rapidly and, within a short period, begin to cause severe damage. Both the nymphs and adults suck the sap from the tender potions of the earheads. In severe infestations, grain formation is often entirely arrested.

Eggs are generally laid between the outer and the inner glumes and sometimes in the centre of the florets. The nymphs hatch out in 5 to 7 days and become adults in 8 to 10 days, *i.e.,* development is completed in 13 to 17 days.

The control of this pest was a problem for a long time, but with the advent of some modern insecticides, it has been solved satisfactorily. As 5 per cent BHC dust was found to have a quick effect, its use was advocated as an approved method of control of this pest. As 10 per cent BHC dust is now largely used against a variety of pests and the difference in price between the two formulations is not appreciable, the same is recommended for the control of this pest too.

The treatment, being simple, cheap and effective, has become very popular with the cultivators of Coimbatore. No *ryot* of this place is indifferent if he observes the pest. In fact, most of them have been trained to such an extent that they are themselves able to spot the pest and adopt remedial measures immediately. Generally, one dusting at the rate of about 15 lbs. of BHC dust per acre is enough but a second dusting may be necessary if there is strong wind at the time of first dusting. For the same reason, some of the *ryots* prefer spraying with BHC (50 per cent wettable powder). Dusting, however, is still very popular as they can cover large areas, using even a muslin cloth in the absence of a dusting machine.

This pest is capable of causing considerable damage to grains and the loss has been assessed to vary from 15 to 30 per cent. Even taking an average figure of 25 per cent the loss will be considerable. The average yield of irrigated *cholam,* in Coimbatore, is about 2,500 lbs. per acre and according to this estimate a *ryot* is likely to lose 625 lbs. of grain, worth Rs. 108 per acre if timely control operations are not undertaken. As it is

the staple food of the agriculturist of this district, it is but natural that he takes so much interest in saving the crop from the ravages of this pest.

The cost of the treatment varies from Rs. 2-8-0 to Rs. 7-8-0 per acre, depending upon the quantity and formulation (*viz.*, dust or spray) of the insecticide used. Even if a maximum of Rs. 7-8-0 is spent, the cultivator stands to save about Rs. 100 per acre.

It is estimated that out of 15,300 acres, about 8,500 acres covering approximately 55 per cent of the area, are annually treated against this pest. The balance of 45 per cent is expected to escape from the pest as a result of early sowing and some natural causes.

INCIDENCE OF SOLITARY HOPPERS OF THE DESERT LOCUST ON SOME DESERT PLANTS

BY

G. N. Bhatia, B.Sc., (Agri.) Hons., Assoc. I.A.R.I.,

Assistant Locust Entomologist,

Directorate of Plant Protection, Quarantine and Storage, Bikaner.

Introduction

The present work embodies the results of surveys made in connection with the concentration of individuals of the desert locust (*Schistocerca gregaria* Forsk.) in the desert areas of India during 1955. Rao (1936, 1940) concluded that the outbreak centres for *Schistocerca gregaria* were mainly situated in Mekran and that Rajputana (Rajasthan) served as a mass breeding area after gregarisation had taken place in Mekran. Gurdas Singh (1951), however, observed that transformation from the solitary to the gregarious phase and formation of incipient swarms of the desert locust could take place under favourable conditions in Rajasthan also. The present author made some observations on the relative incidence of solitary hoppers on various plants in areas where individual locusts breed, with a view to finding out their preference for vegetation for solitary breeding.

Importance

The outbreaks occur as the direct result of multiplication of solitary locusts under favourable conditions, concentration of adults leading to concentrated breeding, and acquiring of gregarious habits. From the brief descriptions of locust breeding areas, given by Rao (1933), it was observed by the author that the coastal dunes (*reks*) and the inland valleys of Mekran showed some similarity in the habitats. Therefore, by noting the vegetation of a particular locality, it may be possible to know whether the area can serve as a potential outbreak centre.

Observations

In 1955, when the locust activity was declining, there were only a few immigrant swarms in India in summer. The population of individual locusts increased due to the incursion of exotic locusts which concentrated in particular localities. As expected (owing to favourable rainfall), breeding of solitary locusts took place in a number of localities in the desert area of Rajasthan. The author took this opportunity for examining some of the solitary breeding areas. Observations were made on the occurrence of various stages of solitary hoppers on various plants in different localities. The results are given in the following table.

INCIDENCE OF SOLITARY HOPPERS OF *SCHISTOCERCA GREGARIA* FORSK. IN 1955 IN BIKANER DISTRICT

Month	No. of localities in which observations were made	Total No. of hoppers collected	Distribution and stage of Hoppers on various plants.						
			Aerua tomentosa (*Booh*)	*Zizypus rotundifolia* (*Borti*)	*Indigofera cordifolia* (*Bekkar*)	*Tribulus terrestris* (*Kanti*)	*Cenchrus biflorus* (*Bhorat*)	*Fagonia cretica* (*Dhamosa*)	*Citrullus colocynthis* (*Tomba*)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
July ..	7	360	325 (I to V)	35 (I)	—	—	—	—	—
August ...	13	161	68 (I to V)	—	1 (V)	80(I) 10(II)	—	1(IV)	1 (III)
September	9	88	11 (I)	—	4 (I)	2 (III)	71 (III to V)	—	—
Total ..	29	609	404 (I to V)	35 (I)	5 (I & V)	92 (I to III)	71 (III to V)	1 (IV)	1 (III)
Percentage of total hoppers			66·3	5·7	0·8	15·1	11·6		

From the table it will be seen that the majority (66.3 per cent) of the solitary hoppers were found on *Aerua tomentosa* Forsk. (*booh*), 15.1 per cent on *Tribulus terrestris* Linn. (*kanti*), 11.6 per cent on *Cenchrus biflorus* Roxb. (*bhorat*), 5.7 per cent on *Zizyphus rotundifolia* (*borti*) and the rest on *Indigofera cordifolia* (*bekkar*), *Fagonia cretica* Linn. (*dhamosa*) and *Citrullus colocynthis* Schrad (*tomba*).

Tribulus terrestris, Zizyphus rotundifolia and *Indigofera cordifolia* harboured mostly younger stages of hoppers, while *Aerua tomentosa* harboured all stages and *Cenchrus biflorus* only advanced stage hoppers (III to V), respectively.

Discussion

Uvarov (1928) mentioned that the selection of a habitat by Acrididae is influenced by the kind and condition of vegetation. A particular habitat is selected by an insect not merely because it contains a preferred food-plant or offers optimum conditions of temperature and humidity, but because the selected habitat provides a suitable combination of all these favourable factors and also offers protection from natural enemies. In July such conditions seem to be fulfilled by *Aerua tomentosa* and *Zizyphus rotundifolia*. Being bushy, these plants provide the hoppers maximum protection from predatory birds. *Tribuls terrestris, Cenchrus biflorus, Indigofera cordifolia* and *Fagonia cretica* hardly grow at that time and hence do not provide any protection to the hoppers from their enemies. By August, *Tribulus terrestris, Indigofera cordifolia,* and *Fagonia cretica* also grow sufficiently (the first two plants are small low creepers while the third is a small shrub with thorns) and provide safety and shelter for the young hoppers. *Fagonia cretica* does not seem to be preferred because of its thorny nature. The older stages are generally not found on *Indigofera cordifolia* as this plant cannot give them sufficient protection from enemies and hence they still remain on *Aerua tomentosa*. During September, the advanced stage hoppers are attracted to *Cenchrus biflorus* Roxb., which is their best host plant at that time. The best spots to look for solitary individuals are, therefore, places where the above kinds of bushes are found.

Acknowledgements

The author is thankful to Dr. K. B. Lal, Plant Protection Adviser to the Government of India, for going through the manuscript of this paper and to Shri Y. Ramachandra Rao for confirming the conclusions arrived at.

References

Gurdas Singh, 1951, *Indian J. Ent.*, 13 (2) : 109—116.

Rao, Y. R., 1933, *Indian J. Agric. Sci.*, 3 (15) : 833—846.

———— , 1936, *Indian J. Agri. Sci., 6* (5): 1031—53.

———— , 1940, *Indian J. Ent., 2* (2): 193—99.

Uvarov, B. P., 1928, Locusts and Grasshoppers (London, Imp. Bur. Ent.).

REVIEW OF PLANT PROTECTION WORK IN MADHYA PRADESH (DECEMBER 1949 TO MARCH 1955)

BY

R. L. GUPTA,

Entomologist to Government, Madhya Pradesh, Nagpur,

AND

S. A. JOSHI,

Plant Protection Assistant, Nagpur.

Introduction

At a conservative estimate, about 10 per cent loss is caused to the standing crops in Madhya Pradesh by pests and diseases, the value of the loss being about Rs. 25 crores annually. One or the other insect pest or disease is always present in the field and the cultivator generally neglects it so long as its intensity is within limits, but when any of these assumes an epidemic form and appears to threaten the prospects of a large crop, the cultivator takes cognizance of it and gets scared. Some energetic cultivators may make a frantic effort, even at this late stage, to carry out control operations. But such belated efforts, even if possible, may not always be remunerative. Suitable control operations, if carried out in time, will not only save further damage to the crop but will also minimise the cost of control operations.

The Entomology and the Mycology Research Sections have been in existence in this State for the past several years. But, for want of properly trained and organised extension staff, the results achieved in the laboratories could not reach the cultivators. The field staff of the Agriculture Department had practically no stock of equipment and pesticides and had, therefore to be contented with giving verbal advice to the needy cultivators. This, without practical demonstrations and on-the-spot help, had almost negligible effect. With the availability of modern pesticides and machinery, it has now become possible to safeguard our crops against a number of pests and diseases at a low cost. To bring home this fact to the cultivator, the State Government started a Plant Protection Scheme in June, 1949.

With the inception of the Plant Protection Scheme, the activities of the staff were mainly concentrated on a large number of practical demonstrations on cultivators' fields to convince them of the usefulness and effectiveness of the pest control measures. This approach has proved very beneficial in furthering the cause of plant protection in the State. This article deals, in brief, with the important activities under this Scheme during the period, December, 1949 to March, 1955.

Staff

From the view-point of agricultural propaganda and cropping system, the Madhya Pradesh State, comprising 22 districts, has been divided into 4 crop zones, *viz.*, (1) rice zone I (5 districts) with headquarters at Raipur; (2) rice zone II (5 districts) with headquarters at Nagpur; (3) cotton zone (6 districts) with headquarters at Amravati; and (4) wheat zone (6 districts) with headquarters at Jabalpur. The work in each zone is under

the control of a zonal Deputy Director of Agriculture, who is assisted by an Extra Assistant Director of Agriculture at the district level, the Agricultural Assistant at the *tehsil* level and a Demonstration *Kamdar* at the village level.

The Plant Protection Scheme was originally started with a staff of 4 Agricultural Assistants (Rs. 150—150—10—250) and 4 Agricultural Overseers (Rs. 60—60—3—90—E.B.—5—125). They were properly trained in plant protection methods for six months and posted in the 4 crop zones of the State under the administrative control of the respective zonal Deputy Directors of Agriculture, and the technical guidance of the Entomologist and the Mycologist to Government, Madhya Pradesh, Nagpur. The Entomologist to Government, Madhya Pradesh, was in over-all charge of the Scheme. This staff was augmented by the appointment of 6 Anti-locust Assistants and 12 Senior Fieldmen in the Anti-locust Scheme and one Research Assistant in the Parasite Breeding Scheme.

Recently one Assistant Entomologist (State Agricultural Class II Service) has been appointed to look after the plant protection work and Anti-locust work of the wheat zone with headquarters at Jabalpur.

Finance

Apart from the expenditure on account of the pay and allowances of staff, the following expenditure was incurred on the purchase and distribution of equipment, insecticides and contingencies of the scheme. These were contributed equally by the Government of India and the State Government. The figures are exclusive of the expenditure on Anti-locust and Parasite Breeding Schemes.

Period of the scheme.	Equipment	Insecticides	Contingencies	Total
	Rs.	Rs.	Rs.	Rs.
1949-50 ..	34,732– 4–6	25,921– 0–0	745– 3–0	61,398– 7–6
1950-51 ..	1,475– 0–3	10,992–12–0	1,983– 9–3	14,451– 5–6
1951-52 ..	22,275–11–3	64,104–14–6	1,803– 9–0	88,184– 2–9
1952-53 ..	7,335–12–6	21,990–10–0	2,035– 1–9	31,361– 8–3
1953-54 ..	36,062–11–6	78,489– 9–0	592–12–9	1,15,135– 1–3
1954-55 ..	77,765– 2–6	1,08,883–14–3	895– 4–3	1,87,544– 5–0
Total ..	1,79,646–10–6	3,10,382–11–9	8,055– 8– 0	4,98,084–14–3

Equipment

Delays in the availability of suitable equipment always handicap field operations. The policy of building up stocks of the necessary equipment was, therefore, adopted from the very beginning. The stocks purchased were kept at several centres in the State to make them readily available for use when required. As the field staff at the *tehsil* and district levels was in direct contact with the cultivators, sufficient stocks were also kept with them for prompt help to the needy cultivators. Use of the equipment is permitted free of cost for pest control operations on cultivators' fields.

The following important equipment, worth Rs. 1,79,646, was purchased under the scheme:—

Equipment	Number
1. Power sprayers	59
2. Power dusters	9
3. Rotary dusters	64
4. Jumbo hand dusters	888
5. Pneumatic sprayers	170
6. Bucket pumps	202
7. Cyanogas pumps	142
8. Seed dressing drums	291
9. Petromax lamps	98
10. Field bags	100
11. Flame throwers	9

In addition to the above, 3 power dusters, 203 rotary dusters and 42 flame-throwers of the Anti-locust scheme were also available.

Pesticides

Sufficient stocks of pesticides were also purchased from time to time and kept at the centres along with the equipment. Use of pesticides was permitted free of cost in the first two years of the scheme but as the work progressed and the demand for pesticides increased, the free supply of pesticides was partially substituted by sale at 50 per cent subsidised price. However, for the control of epidemics, free use of the pesticides is still permitted. The following quantities of some of the commonly used pesticides worth Rs. 3,10,382 have so far been purchased:—

Pesticides	Quantity	
	Tons	cwt.
BHC & DDT (various formulations)	212	12
Other insecticides like Nicotine sulphate, Lead arsenate, Fish oil Rosin soap, etc.	12	1
Seed dressing fungicides	8	17 1/2
Other fungicides like Sulphur and Copper compounds.	28	13
Rodenticides	3	1
Weedicides	0	11 1/4
Total	265	15 3/4

In addition, 37 tons of 10 per cent BHC and 1½ tons of Aldrin of the Anti-locust scheme were also available.

Programme of work

The work of the staff engaged in the scheme mainly consisted of (1) field application and propaganda of effective and economic methods of control evolved in the Entomological and Mycological laboratories of the State; (2) field survey of the incidence of pests, diseases and weeds; (3) field trials of equipment, insecticides and weedicides; (4) field observations on natural and liberated parasites for biological control; and (5) training, assistance and guidance to the field and demonstration staff of the Agriculture department for plant protection work.

Training

Four Agricultural Assistants and four Agricultural Overseers (now Plant Protection Assistants and Plant Protection Overseers) were trained for six months (June to December '49) under the Entomologist and the Mycologist to Government, Madhya Pradesh, Nagpur. This was followed by the training of a batch of 17 Agricultural Assistants (15 days in Entomology and 15 days in Mycology) and another batch of 10 Agricultural Assistants (1 month in Entomology and 1 month in Mycology) who are on regular demonstration duties. Training was also given to the Agricultural Assistants employed in the National Extension Service of the State in their respective centres. The training of the Agricultural Overseers and Demonstration *Kamdars* (Village Level Workers or Gram Sevaks) was conducted at their training centres and also at the district centres.

Pests and diseases tackled

Rice: The paddy grasshopper (*Hieroglyphus banian* Fb.) appeared in an epidemic form in 1949-50 and 1950-51, particularly in the Durg, Raipur and Mandla districts. The pest was effectively controlled by dusting the infested crop and surrounding *bunds* with 5 per cent BHC at the rate of 15—20 lbs. per acre. Scrapping of *bunds* for destruction of egg masses was done. Field bags were also used for collecting the hoppers and the adults. *Gangai, ponga* or *gad* disease of rice (*Pachydiplosis oryzae* Wood-Mason) was mainly noted in Balaghat and Bhandara districts in the years 1948-49, 1949-50 and 1952-53. Light-trap method of control was widely adopted. Application of Ammonium sulphate at the rate of 50 lbs. per acre proved helpful in promoting plant growth and thus warding off the pest attack. The swarming caterpillar (*Spodoptera mauritia* Boisd.) and the army worm (*Cirphis unipuncta* Haw.) appeared in an epidemic form in the year 1952-53 (July, August and September). The pests first appeared on grasslands and later on migrated to paddy fields. This was noted in Balaghat, Chanda, Bhandara, Durg, Nagpur and Mandla districts. Sporadic attacks were also noted in the subsequent years. The pest was effectively controlled by dusting the infested crop and surrounding grasslands with 5 per cent BHC at 15 to 20 lbs. per acre. Kerosene film method was also adopted in paddy bunds wherever water was available. The caterpillars were dislodged in the kerosenised water, by passing a rope over the standing crop, where they were killed. *Gundhi* bug of rice (*Leptocorisa varicornis* Fb.) suddenly appeared in an epidemic form late in September 1952 and, within a week, it spread so quickly that it was found to affect the early paddy varieties in Raigarh, Surguja, Raipur, Bilaspur, Durg, Balaghat, Jabalpur and Mandla districts. Extensive control measures were adopted by mobilising all the available resources. The pest was controlled by (*i*) dusting the crop with 5 per cent BHC, (*ii*) field

bagging of nymphs and adults and by (*iii*) the kerosenised film method. Simultaneously, this pest was also reported in the paddy areas of Bihar, Orissa, Uttar Pradesh and Vindhya Pradesh. As a special case, the State Government ordered the issue of small hand dusters and insecticides on subsidised *taccavi* basis. *Maho* (*Nephotettix bipunctatus* Fb.) was of regular occurrence in Raipur, Bilaspur and Raigarh districts. It was effectively controlled by spraying the nursery and standing crop with 0.16% DDT and by the use of light-traps in the fields. The rice hispa (*Hispa armigera* 01.) and the rice case worm (*Nymphula depunctalis* Guen.) were occasionally noted on a small scale in Nagpur and Chanda districts. Dusting with 5 per cent BHC was found effective in controlling them.

For the control of seed-borne diseases of paddy, seed dressing with mercury fungicides before sowing was recommended.

Jowar: The stem borer of *jowar* (*Chilo zonellus* Swinh.) was of common occurrence in all the *jowar* and maize growing areas of the State. It could only be checked in the early stages by spraying 0.16 per cent DDT or dusting 5 per cent BHC. Clean cultivation, including the burning of stubbles, was also recommended. The *jowar* Fulgorid (*Pundaluoya simplicia* Dist.) and the *jowar* aphids were controlled by spraying 0.16 per cent DDT or dusting 5 per cent BHC.

The seed-borne diseases (grain smut and loose smut) were effectively controlled by pre-sowing seed-dressing with mercurial compounds and Copper carbonate. The method, being cheap and easy, has become very popular with the cultivators.

Cotton: The pink boll worm (*Platyedra gossypiella* Saund.) and the spotted boll worm (*Earias fabia* Stoll.) were mainly noted in Nagpur, Wardha, Akola and Amravati districts. 'Clean-up' methods were helpful in checking the pests. Sun-drying of seeds for about a couple of days in May killed the resting larvae of the pink boll worm. Dusting 5 per cent BHC or spraying 0.16 per cent DDT was helpful in checking the spotted boll worm in the early stage of the crop. The cotton jassid (*Empoasca devastans* D.) has been severely affecting the broad-lobed varieties of cotton for the last three years. This, however, was controlled by spraying the crop with 0.16 per cent DDT or 0.16 per cent BHC. Aphids were noted on all varieties of cotton. They were controlled by spraying with a mixture of Fish oil Rosin soap and Nicotine sulphate. BHC 5 per cent dust was also used with success.

For the control of seed-borne diseases, especially the seedling blight and anthracnose, pre-sowing seed-dressing with mercurial compounds was resorted to, with success. The method has gained popularity amongst the cultivators.

Gram: The gram caterpillar (*Heliothis armigera* Hb.) was observed to be a serious pest of gram in wheat growing areas of the State. It was successfully controlled by dusting the crop with 5 per cent BHC. Field trials of controlling the pest with the egg-parasite *Trichogramma minutum* Riley are in progress.

Wheat: Foot rot of wheat was widely noted in the wheat tract. Pre-sowing treatment of seeds with mercurial compounds (Agrosan GN) was adopted with success.

Of late, damage to wheat crop due to white ants is reported from Hoshangabad district. The colonies of mound building species in the fields

were cyanogassed. Trials are in progress in regard to soil treatment with BHC, DDT, Aldrin and Dieldrin against the field termites. Jassids on wheat were controlled by spraying the crop with 0.16 per cent DDT.

Groundnut: A severe outbreak of aphids on groundnut was observed in Amravati and Akola districts in the year 1951-52. In subsequent years also, the occurrence of the pest was observed. Although spraying of Fish oil Rosin Soap with Nicotine sulphate gave a very good kill of the insects the non-availability of water for spraying restricted the wide-scale use of this method. Dusting 5 per cent BHC was partially effective. The natural predators, *viz.*, the ladybird beetles proved very helpful in completely checking the pest. These predators were collected from the infested fields and nearby gardens, where they were in abundance, and liberated in the aphid-infested fields.

The *tikka* or leaf spot disease of groundnut was observed in a few isolated areas. This was effectively controlled by spraying Bordeaux mixture (2 : 2 : 50). In addition to the effective control of the disease, the spraying was helpful in stimulating plant growth.

Citrus: Madhya Pradesh is famous for its oranges. The orange growing areas are particularly located in Nagpur, Chhindwara, Wardha and Amravati districts. The general experience of plant protection work in orange gardens indicated that the plants were comparatively free from pests and diseases so long as they were well attended to in respect of clean cultivation, manuring and irrigation. Neglect or lack of any of these, usually resulted in the weakening of the plants, making them more susceptible to a number of pests and diseases. Neglected plants harboured pests and disease and thus became a source of infestation to healthy plants. The necessity of clean cultivation and proper gardening methods from plant protection point of view was, therefore, stressed on the orange growers.

The beetle borer of orange (*Stromatium barbatum* Fb.) was found in almost all the orange gardens where the plants carried dried branches. Both the dried and the living branches were attacked by the pest. Pruning of the dried branches with some portion of the living branch was recommended. Crude creosote or crude oil emulsion was pasted to the cut or exposed surface. This was helpful in checking the pest. The beetles are also attracted to light traps.

The moth borer of orange (*Indarbela quadrinotata* Wlk.) was responsible for damaging citrus trees of all ages. It attacked other fruit trees also. Use of EDCT mixture proved most effective in controlling this pest. The use of petrol and 5 per cent BHC dust also gave good results. The fruit moths (*Othreis fullonia* Cl., *O. materna* Linn. and *Achoea* spp.) were responsible for a heavy damage to the *'Ambia bahar'* crop of orange and *mosambi*. As much as 30 to 40 per cent damage was of common occurrence. Eradication of gurbel creepers (*Tinospora cordifolia*) in the vicinity of the orchards helped considerably in checking the pest. Spraying the fruits and trees with 0.16 per cent DDT was done with success. Field trials of controlling this pest by liberating egg-parasites (*Trichogramma minutum* Riley) are in progress. Another field trial for control with mothbaits of *gur-rub* is also in progress. The lemon butterfly (*Papilio demoleus* Linn), the citrus leaf miner (*Phyllocnistis citrella* St.), the citrus leaf roller (*Tonica zizyphi* Sk.) and the citrus white fly (*Aleurocanthus spiniferus* Q.) were also noted in a few cases. Of these, the lemon

butterfly was easily controlled with a spray of Lead arsenate at the rate of 1 oz. in 4 gallons of water and the other three pests were controlled with Fish oil rosin soap and Nicotine sulphate in the usual doses.

A number of orange trees on heavy and water-logged soils were found infected by a number of plant diseases, the most prominent being gummosis. Improving the soil aeration, manuring, cleaning and painting of diseased portion with Bordeaux paste were found to be very effective in controlling this disease.

Mango: The mango hoppers (*Idiocerus* spp.) caused serious damage to new shoots and blossoms of mango trees in Chhindwara (Seoni area) and Balaghat (Lalburra area) districts. Spraying 0.16 per cent DDT mixed with sulphur checked the pest.

Powdery mildew on mango blossom was also noted. Sulphur dusting proved effective in controlling this disease.

Brinjal: The brinjal fruit borer (*Leucinodes orbonalis* G.) and the brinjal stem borer (*Euzophera perticella* R.) were of common occurrence on brinjal crop. Spraying 0.16 per cent DDT or dusting 5 per cent BHC kept these pests under check. Outbreaks of jassids on brinjal were reported from Nagpur district in 1950-51 and subsequent years. Spraying of Fish oil rosin soap with Nicotine sulphate was very effective in controlling this pest.

Chillies: Damage to chilli crop by leaf-curl due to thrips and mites was noted every year. Spraying of Lime sulphur wash was generally recommended. Field trials for control of the same with some of the modern pesticides and acaricides are in progress.

Die-back of chillies was noted in the Berar districts. Spraying of Bordeaux mixture kept the disease under control.

Ginger: The ginger fly (*Mimegralla coeruloifrons* Macq.) was noted in Chhindwara district. Subsequent investigations, however, revealed that the fly maggots were found only on rotting rhizomes infected with *Pythium* spp., which shows that the fly is only a scavenger. Fumigation of the rhizomes for seed was, however, undertaken to check the further spread of the insect. Experiments for the control of rhizome rot due to *Pythium* spp., are in progress.

Onion: The onion crop in Amravati district usually suffered from an attack of thrips. Spraying 0.16 per cent DDT proved very effective in keeping the pest under control.

Potato: The potato cut-worm (*Agrotis ypsilon* Rott.) occurred sporadically in Chhindwara district. Dusting 5 per cent BHC proved effective in controlling this pest. Application of crude oil emulsion in irrigation water also helped in checking the damage due to this insect. The potato tuber moth (*Gnorimoschema operculella* Zell.) was noted mainly as a storage pest, although the insect also caused some damage to potato crop in the fields. Fumigation of potatoes in storage with EDCT mixture proved effective in checking the pest. Application of crude-oil emulsion to the irrigation water in infested fields also helped in checking the damage due to these two pests.

Early blight of potatoes was reported in isolated cases. Spraying of Bordeaux mixture kept the disease under control.

Cabbage, Cauliflower, etc. : The cruciferous plants were usually infested by mustard saw fly (*Athalia proxima* Klug.). Spraying with Lead arsenate (¾ oz. in 4 gallons of water) or dusting 5 per cent BHC was found effective in controlling this pest. The tobacco caterpillar (*Prodenia litura* Fb.) was occasionally observed. Dusting 5 per cent BHC controlled this pest.

Cucurbits: The red pumpkin beetle (*Aulacophora abdominalis* Fb.) was usually noted on pumpkins. Spraying of Lead arsenate (¾ oz. in 4 gallons of water) and Fish oil rosin soap (2 oz. in 4 gallons of water) controlled this pest.

Singhara : Damage to this crop by the *singhara* bettle (*Galerucella birmanica* J.) was a common feature in *singhara* cultivation. About 50 per cent damage was noted in a number of cases. Dusting 5 per cent BHC, however, brought down the damage due to this pest. This was done only in tanks where water was not used for drinking purposes or fish breeding.

Betelvine : The *pan* bug (*Disphinctus politus* Wlk.) was noted in Amravati district in 1954-55. Immediate control operations by spraying the infested crop with 0.16 per cent DDT or Fish oil rosin soap and Nicotine sulphate, were undertaken, which kept the pest under control.

Of the *pan* diseases, foot rot and anthracnose are of very common occurrence in the *pan barejas* of this State. Regular spraying of the *pan*-vines and occasional soil treatment with Bordeaux mixture were recommended.

Storage Pests of Grains and Cereals: Damage to cereals and other grains in storage by beetles and moths was observed invariably. Some of the important pests were *Sitophilus oryzae* Linn., *Trogoderma granaria* E., *Tribolium castaneum* H., *Bruchus* sp., *Rhizopertha dominica* Fb., *Sitotroga cerealella* Ol., and *Corcyra cephalonica* Staint. In addition to these, damage was also caused by rats. Safe storage methods were always adopted for storage of departmental seeds and cultivators were advised to follow them.

Rats: Control of rats in fields and godowns was a useful item of plant protection work. Cyanogassing of the rat burrows was undertaken wherever possible. In other cases Zinc phosphide baiting always gave good results.

Porcupines: In 1950-51, severe damage to field crops, due to porcupines, was reported from 15 villages of Wardha district. Large scale control operation, by cyanogassing the porcupine burrows in all these villages, was immediately undertaken with success. This large scale operation kept the pest under check for another three years or so.

Weed Control: Due to the prevailing system of growing mixed crops (dicots and monocots), selective weed killers had very restricted use. However, the use of 2, 4-D was recommended for control of *gokhru* (*Xanthium strumarium* Linn.) and *tarota* (*Cassia tora* Linn.), which brought about complete kill in case of *Xanthium strumarium* and partial kill in *tarota*. This further helped in getting a good growth of grass on

bundhs and boundaries of fields, and also checked, to some extent, further dissemination of the seeds of these weeds in nearby fields. Experiments on different aspects of weed control are in progress.

The following are some of the main achievements of the work done under the Plant Protection Scheme during the period December 1949 to March 1955.

Item of work	Area treated in acres	Estimated saving in rupees
Seed borne diseases of *jowar*, cotton & wheat	8,36,417	58,44,858
Pests and diseases of paddy	5,967	61,490
Pests and diseases of wheat	14,911	45,834
Pests and diseases of citrus	4,131	2,17,797
Pests and diseases of vegetable and other garden crops ..	4,987	4,09,924
Pests and diseases of other field crops	3,588	5,459
Safe storage of wheat seed	7,988 tons	1,42,159
Control of rats	249 godowns and 6,390 acres	5,41,298
Porcupines	15 villages	30,000
	Total ..	73,52,819

SHORT NOTE

DAMAGE CAUSED BY TORTOISES TO *singhara* CROP IN UTTAR PRADESH.

Since the publication of a short note on the subject in the June, 1954 issue (Vol. VI, No. 2) of the Plant Protection Bulletin, some more information regarding the damage has been collected. The information from Etawah district indicates that damage by tortoises to *singhara* (*Trapa bispinosa* Roxb.) is confined to soft and thornless fruits only, as in Meerut district. The extent of damage in Etawah varied from 12½ per cent to 25 per cent of the crop. The method adopted for minimising the damage is to tie roasted intestines of a goat to a pole and to immerse it in water in the pond so as to attract the tortoises to the bait. When a good number of tortoises have collected round the pole, they are caught by some indigenous method and transferred to some other water reservoir, where *singhara* crop is not grown. Some cultivators also use nets for catching them.

In Azamgarh and Shahjahanpur districts also the extent of the damage caused to *singhara* crop by tortoises varied from 10 per cent to 20 per cent in the former and from 10 per cent to 15 per cent in the latter district.

A. S. SRIVASTAVA,
Entomologist to Government, Uttar Pradesh and Officer-in-Charge, Plant Protection Service, Uttar Pradesh, Kanpur.

NEWS AND NOTES

I. International Plant Protection Convention

In 1955 the Director General, FAO, invited to Rome, for the period 19th to 23rd September, 1955, nine specialists in the field of Plant Protection from member countries and asked them to advise about certain proposed amendments to the International Plant Protection Convention of 1951 and to apprise him about the current activities of the FAO in the Plant Protection field and also advise with respect to desirable future course of action. The nine specialists, who were to serve as individuals rather than as representatives of their governments, were Dr. C. J. Briejer, Netherlands, Mr. M. P. Dumas, France, Dr. S. B. Fracker, U.S.A., Dr. E. Gram, Denmark, Dr. T. H. Harrison, Australia, Mr. P. G. Inch, England, Mr. W. N. Keenar, Canada, Dr. K. B. Lal, India and Ing. Agr. Angel G. Stura, Argentina.

After various considerations and discussions the Committee, constituted by the nine specialists, made 16 recommendations some of which are as follows:—

(1) The use of the present form of model certificate, as given in the International Plant Protection Convention of 1951, be continued and that it be accepted when expressed in any one of the three official languages of the FAO, namely, English, French and Spanish.

(2) The certification requirements for seed be limited to specific diseases of designated kinds of seeds and that generally certificates should not be asked for with respect to small packets unless there was a specific reason for doing so.

(3) No amendments to the text of the International Plant Protection Convention or of its model certificate were necessary, though, when some experience had been gained in the operation of the Convention, suggestions for changes received from various governments be given further consideration.

(4) Pot plants be considered as material intended for planting under the International Plant Protection Convention.

(5) Plant materials intended for scientific purposes should be imported and utilised only under full quarantine safeguards.

(6) Manufactured material of plant origin be considered as coming within the purview of the Convention so long as the process of manufacture has not eliminated or substantially reduced the likelihood of its transmitting insect pests or plant diseases.

(7) The utilisation of fellowships in providing plant protection training be encouraged and promoted.

(8) The World Reporting Service on plant diseases and pests established by FAO be continued and that member countries

be further encouraged to cooperate in providing reports promptly.

(9) The publication of the Digest of Plant Quarantine Regulations initiated by FAO should be continued.

II. F.A.O. Locust Meetings

(1) The Fifth Session of the FAO Technical Advisory Committee on Desert Locust Control was held in Damascus, Syria, from 4th to 6th August, 1955. The first three Sessions of the Committee were held in Rome and the fourth Session in Cairo in March, 1952, November, 1952, April, 1953 and June, 1954, respectively. The Committee is constituted of the representatives of the Governments of Egypt, France, Iran, India, Pakistan, United Kingdom and United States of America. In the meeting at Damascus, representatives from all these countries, except India, were present.

As its name implies, the function of the Committee is to advise the Director General, FAO, about the desert locust situation in various parts of the distribution region of this pest and the technical developments in its control as well as about various problems of investigations, surveys, training, etc., in regard to the desert locust. The Committee at Damascus made various recommendations regarding poison baits and poison baiting, ground dusting and spraying, treatment of egg fields, air to air and air to ground sprayings, control techniques in relation to control operations in the Arabian Peninsula, etc. The Committee also recommended that the Director General of FAO be requested to appoint a small panel of five experts for a critical assessment of the available knowledge on desert locust and for the preparation of detailed proposals for investigations on this pest.

(2) The Second Session of the FAO Desert Locust Control Committee was held in Bloudan, Syria, from 14th to 17th August, 1955 and was attended by delegations from Egypt, France, Iran, Iraq, Italy, Jordan, Lebanon, Libya, Pakistan, Saudi Arabia, Syria, Turkey, United Kingdom, United States of America and Yeman as well as by representatives from Sudan, observers from the Arab League and Canada and FAO staff. The Governments of Afghanistan, Ethiopia, and India apologised for their inability to depute delegates to participate in the Session. The First Session of the Committee was held in Rome in April, 1955, in which the Government of India was represented by Dr. K. B. Lal, Plant Protection Adviser to the Government of India. The main function of the Committee was to consider the desert locust situation and the results of the anti-locust campaign conducted in the Arabian Peninsula during 1954-55 under the auspices of the FAO and to recommend plans for similar operations in the Arabian Peninsula during 1955-56.

The Committee estimated that the total expenditure incurred by participating Governments and organisations on the 1954-55 campaign was approximately U.S. $ 1,300,000 and indicated that the total cost of the 1955-56 campaign in the Arabian Peninsula would amount approximately to U.S. $ 1,528,765.

III. Anti-Locust Missions

(1) At the invitation of the FAO, the Government of India deputed a self-contained Anti-Locust Mission for locust survey and control operations in certain parts of Kuwait and Saudi Arabia. The Mission consisted of 28

officials and carried 12 motor vehicles, 209 power and hand operated dusting machines, 200 tons of 10 per cent BHC dust and various other types of stores and equipment. The Mission left India on 28th January, and returned in June, 1955. By all accounts the operations conducted by the Indian Mission in Kuwait and Saudi Arabia were highly successful and greatly appreciated.

(2) A similar Anti-Locust Mission was deputed by the Govt. of India to conduct locust survey and control operations in Saudi Arabia in 1956. The Mission, which consisted of 30 officials and carried 13 vehicles 209 spraying and dusting machines, 100 tons of 10 per cent BHC dust and other equipment, left Bombay for Saudi Arabia on 23rd January, 1956, returning in two batches on 29th May, 1956 and 4th June, 1956, respectively.

IV. Indian Delegation to Russia

During the summer of 1955, the United Nations Technical Assistance Administration sponsored, at the invitation of the U.S.S.R. Government, a study tour of 13 officers of the Government of India to the U.S.S.R. with the object of observing facilities of scientific and technical nature available in that country. Of the 13 officers nominated by the Government of India, two, namely, Shri C. R. Ranganathan, Inspector General of Forests, and Dr. K. B. Lal, Plant Protection Adviser, were from the Ministry of Food and Agriculture. The delegation left New Delhi on the 31st May, for Moscow *via* Kabul and Tashkent and returned to New Delhi on the 6th July, 1955.

During his study tour, Dr. Lal, along with other members of the delegation, visited 49 institutions and organisations in Moscow, Leningrad, Kieve, Kharakov, Tbilisi, Makhratza and Tashkent. Of particular interest to plant protection, were his visits to the Scientific Research Institute for Plant Protection in Leningrad, Plant Protection Station, Pushkino-Leningrad, and various State and Collective farms. As in other fields of agriculture, plant protection in Russia is highly mechanised and one of the members of the delegation obtained the information that about 5,000 aeroplanes are used for aerial dusting and spraying of crops against pests and diseases.

CURRENT LITERATURE

(1) A List of The Insects of Mysore Including The Mites by S. Usman and M. Puttarudraiah of the Department of Agriculture, Mysore State, Entomology Series—Bulletin No. 16, Bangalore 1955, pages 194, vi, price Rs. 1.56.

As the name indicates, the publication contains a briefly annotated list of insects and mites collected from time to time in Mysore State. The list, which is arranged according to insect orders and families contains not only pest insects but also those which act as parasites or predators as well as those which may be at present of no agricultural importance. At the end, there are 72 references to literature, including one on Acarina and a 28-page index.

(2) Plant Protection in Madhya Pradesh by R. L. Gupta and S. A. Joshi, Government of Madhya Pradesh, Agriculture Department, Bulletin No. 50 of 1955, pages 41, price Rs. 0.50.

The publication contains six chapters and two appendices. The chapters deal with the development of plant protection in Madhya Pradesh, a review of plant protection work in Madhya Pradesh during 1948—1955, important insect pests of crops, some common control measures in vogue against pests, pesticides and their uses and plant protection equipment. Appendix A contains some instructions for sending specimens to the State Entomologist for identification and Appendix B gives a list of firms dealing with pesticides and equipment in India.

(3) Entomology Section—A Brief Review—1948—1955, published by the Department of Agriculture, Government of West Bengal.

This is a brief review of the work done in the Entomology Section of West Bengal Department of Agriculture during 1948—55. The various items of work done on the pests of brinjal, cotton, jute, mustard, paddy, potato, mango and sugarcane, etc., are tabulated and the results obtained in respect of each briefly mentioned. Brief reports of a systematic study of the Aphididae of West Bengal and investigations on the control of stored grain pests with bacteria and antibiotics are also given.

(4) Crop Protection by G. J. Rose, Leonard Hill Limited, London, 1955, pages 223, xxi.

With the exception of a three and a half page Introduction and a two-page chapter on cultural control, the book deals entirely with 'Crop Protection Chemicals and Equipment'. It is divided into four Sections dealing respectively with (*i*) formulations, (*ii*) chemicals, (*iii*) application machinery, and (*iv*) storage. Within this range there is a wealth of information given about pesticides, both old and new, plant protection machines and equipment for spraying, dusting, seed dressing, soil sterilisation, flame throwing, etc. Under "Summary of Control Measures" towards the end of the book, various pests and diseases are mentioned crop-wise and methods of chemical control against each indicated. In the Introduction, the methods of controlling pests, weeds and diseases are classified into the five categories of (*i*) ecological control, (*ii*) cultural control, (*iii*) biological

control, (*iv*) control by breeding of resistant strains of crops, and (*v*) chemical control. The category of control by mechanical means, which is still practised in India and some other countries with advantage under certain conditions, is not mentioned. Somewhat inappropriately, Section I, dealing with formulations, opens with its first chapter on cultural control. The book has 113 illustrations, many of which are coloured.

(5) Practical Plant Protection by E. Holmes, Constable & Company Ltd., London, 1955, pages 252.

As the author states in his Preface, "This book is intended as a review of the best plant protection practices likely to be of use to the grower rather than a text book of academic facts; it deals almost exclusively with problems in Great Britain". Still plant protection workers all over the world may well find many of their own problems and experiences reproduced, though in different contexts, somewhere or other in the book. After briefly mentioning the cultural, mechanical and biological methods of control, the author states that "Now and for some long time to come the grower must look to the chemist to provide the chief means of control for most of his more troublesome insect pests, fungus diseases and weeds". It would be rather difficult to disagree with this view. Somewhat logically, therefore, practically the whole book is devoted to a discussion of the chemical method of pest and disease control in its various aspects. The short descriptions of pests, diseases and weeds are given only to the extent to which they may be of use to the intelligent and practical farmer. Apart from insects, such other animal pests as rabbits, squirrels, rats, snails, eelworms, etc., are also included. A chapter is devoted to deficiency diseases, another to plant protection chemicals and beneficial organisms and yet another to the various factors involved in the dusting and spraying of crops, etc. Various forms in which pesticides may be used are discussed in some detail. The book contains nine photographic illustrations.

(6) Guide Showing Methods To Control Crop Pests And Diseases by V. Tirumala Rao, P. Govinda Rao and P. V. Ranga Rao. Bulletin No. 1, 1954. Issued by the Department of Agriculture and Fisheries, Andhra, pages 141.

The publication contains crop-wise lists of insect and other pests as well as diseases known to damage crops, fruit trees, plantations and other useful trees as well as stored agricultural products. The lists give the common and scientific names of the pests and the diseases, the nature of damage done by them and the control measures practised against them in Andhra State. A similar list is also given of the pests which may attack or trouble cattle and other domestic animals. Most of the control measures given involve dusting, spraying or poison baiting with pesticides. There are six appendices relating respectively to insecticides, table of spray dilutions, compatibility of common spray materials, antidotes for insecticidal poisoning, instructions for reporting damage by pests and the grouping of pests according to their natural orders, with information on their food plants. An unnumbered appendix at the end gives some recipes for treatment against fungus diseases. It is noteworthy that out of 141 pages of the book, excluding the preface and the table of contents, only 13 are devoted to plant diseases. Although the control measures given may need modifications in some respects and at times, the publication should prove very helpful for plant protection and other extension workers.

(7) Hand Book of Plant Protection by S. Chowdhury and S. Majid, Department of Agriculture, Assam, 1954, pages 117.

The publication contains crop-wise lists of major plant diseases and insect pests of agricultural importance in Assam, followed by short notes on them with indications for their control. A small chapter deals with locusts and the methods of their control, which, however, are mostly those conventionally recommended. There are separate chapters or sections dealing with the storage of foodgrains, rats, porcupines, squirrels, crabs, snails, slugs and other animals, control of weeds, pesticides and spraying and dusting machinery. An appendix gives a brief account of the Plant Protection Service in Assam and another gives some general advice about the purchase of pesticides and plant protection equipment, etc. The publication is illustrated and contains a wealth of interesting and useful information.

K. B. LAL

L45M of F&A—9-3-59—(Sec. II)—500—GIPF,